CRUISE REPORT FOR THE LAKE TANGANYIKA BIODIVERSITY PROGRAM PALEOLIMNOLOGY SUBCOMPONENT OF SEDIMENTATION STUDY CRUISE PERIOD 6-28 JAN., 1998

Prepared by Andrew S. Cohen (Principal Investigator) and Manuel Palacios

Department of Geosciences
University of Arizona
Tucson, AZ 85721
USA

for the Natural Resources Institute

Operations

A research cruise directed by the University of Arizona under contract to the Lake Tanganyika Biodiversity Project and the Natural Resources Institute was held in January, 1998. The purpose of this cruise was to collect bathymetric data, sediment cores and water samples as part of an investigation of the long term changes in sedimentation rates resulting from watershed deforestation and subsequent soil erosion, and the effects those changes may have had on the ecology of Lake Tanganyika. Cruise operations were divided into 3 legs of varying duration, working in both Tanzanian and Burundian waters of the lake. The dates and participant lists for each leg are listed in Table 1.

Study Localities

Data collection and sampling for this research cruise was organized around a strategy of collecting information about sedimentation impacts and rates around a variety of sized river deltas. To select appropriate study localities, highly disturbed and relatively undisturbed drainage basins were paired on the basis of similarities in drainage basin area, and to the extent possible, geomorphology and bedrock geology. Study locality pairs were as follows:

Study localities incorporating two drainages are those where the two rivers discharge in close proximity along the lakeshore and where the deltas of those rivers merge offshore. In such cases it is unlikely that deposits of the two systems could be differentiated without much more extensive work. Therefore those localities can be treated as single "deltas" for the purposes of this study. The original cruise plan called for a study of the Mitumba Stream Delta as the example of an undisturbed, very small drainage. This drainage basin is directly adjacent to, and approximately the same size (5.5km2) as the Mwamgongo disturbed drainage. However bathymetric surveys and extensive coring attempts at this locality demonstrated that this site was too steep to allow for the successful operation of either the multicorer or gravity corer. The Luiche River Delta locality was added because coring was completed ahead of schedule for the first leg objectives, but it was not possible to depart early for the second leg objectives (in Burundi) until all second leg scientific crew had arrived in Kigoma. It would be valuable to obtain comparative cores from an undisturbed drainage of similar size and geomorphology, such as the Luamfi (southern Tanzania) during any future coring cruises.

TABLE 1. LAKE TANGANYIKA SPECIAL STUDIES ON SEDIMENTATION CRUISE PARTICIPANT LIST

Leg 1 (6-16 Jan., 1998)
Dr. Andrew Cohen-University of Arizona-Project Leader and Chief Scientist
Dr. Manuel Palacios Fest-University of Arizona- Paleontologist
Mr. Jeffrey Houser-University of Wisconsin-Limnologist
Mr. James McGill-Embangweni Hospital-Coring Engineer
Ms. Emma Msaky-Tanzania Petroleum Development Corporation-Tanzanian Trainee
Ms. Catherine O'Reilly-University of Arizona-Limnologist
Dr. Graeme Patterson-NRI-Sedimentation Special Study Team Leader
Robert Sinyinza-Zambia Dept. of Fisheries-Zambian Trainee

Dr. Peter Swarzenski-U.S. Geological Survey, Geochemist
Mutanga Syampila-Zambia Dept. of Fisheries-Zambian Trainee
Dr. Dirk Verschuren-University of Ghent-Paleolimnologist

Leg 2 (19-24 Jan., 1998)
Dr. Andrew Cohen-University of Arizona-Project Leader and Chief Scientist
Dr. Manuel Palacios Fest-University of Arizona- Paleontologist
Dr. David Dettman-University of Arizona-Geochemist
Mr. Jeffrey Houser-University of Wisconsin-Limnologist
Dr. Kiram Lezzar-Univ. of West Brittany-Paleolimnologist
Mr. James McGill-Embangweni Hospital-Coring Engineer
Ms. Catherine O'Reilly-University of Arizona-Limnologist
Robert Sinyinza-Zambia Dept. of Fisheries-Zambian Trainee
Mutanga Syampila-Zambia Dept. of Fisheries-Zambian Trainee

Leg 3 (24-28 Jan, 1998)
Dr. Manuel Palacios Fest-University of Arizona- Paleontologist and Chief Scientist for Leg 3
Dr. Gaspard Bikwemu-University of Burundi-Palynologist
Dr. David Dettman-University of Arizona-Geochemist
Mr. Jeffrey Houser-University of Wisconsin-Limnologist
Mr. Bombi Kakagozo- CRH/Uvira, Zaire-Limnologist
Dr. Kiram Lezzar-Univ. of West Brittany-Paleolimnologist
Dr. Louis Nahimana-Univ. of Burundi-Sedimentologist
Dr. Gerard Ntungumburanye-IGEBU-Burundi-Geologist
Ms. Catherine O'Reilly-University of Arizona-Limnologist
Mr. Tharcisse Songori-Direction Gen. Geologie et Mines (Burundi)-Geologist
Dr. Kelly West-LTBP-Scientific Coordinator

TABLE 2. DELTAS STUDIED IN THIS PROJECT

Bathymetric Surveys

Prior to coring, detailed bathymetric surveys were conducted at all study localities. Generally these surveys were performed on a half-kilometer spacing grid, with depth and location data collected every 0.05 or 0.02 nautical miles along a transect line. Crude bathymetric maps were constructed by hand in the field to identify promising coring sites (i.e. sites which were both relatively flat and at an appropriate range of depths and distances from the river mouth).Preliminary bathymetric maps (produced with Surfer for Windows software) are shown in Figure 1. Aside from the intrinsic value of these surveys for future navigational reference (they are far more detailed than any prior bathymetric surveys available for any parts of the lake), these maps can be used in a second phase of this project in the construction of a computer model relating sediment accumulation rate data to predicted erosion rates within watersheds.

Coring Operations

Once an adequate amount of bathymetric data had been collected for a locality to reconstruct the general geomorphology of its delta, coring operations could begin. Most coring work in this survey was undertaken using the LTBP's Hedrick-Marrs Multicorer. Under optimal conditions this device will collect four cores up to 57cm in length, each with a 10cm inner diameter. The cores are arrayed in a square grid that separates the center of each core from its neighbors by about 30cm. This arrangement allows the investigator to sample the same stratigraphic horizon from multiple core barrels (the device does not use a separate core barrel and liner). This coring device functioned extremely well, despite the frequently suboptimal coring conditions (high slope angle and coarse sediments) and almost every successful cast produced cores that had undisturbed tops (frequently, still living snails, copepods and ostracodes could be observed trapped in the surface waters of the core). Because the R/V Tanganyika Explorer is not optimized for geologic sampling (there is no functional boom or A-frame and the winches are oriented at an angle with respect to the stern of the ship) deploying and retrieving the corer over the rail proved somewhat unwieldy, and an effort was made to tie off the corer to the ship's rail when moving between closely adjacent core sites, or between coring attempts. It is recommended that LTBP rectify this problem prior to any future coring work by installing the necessary cabling and

winch adapters to make the R/V Tanganyika Explorer's boom functional, or alternatively to install a stern mounted A-frame that can hoist the multicorer and other coring devices over the rail more easily and safely.

Between 0 and 7 multicores were collected from each delta locality (Table 3). At several deltas very few or no multicores were collected because slopes were too steep across the entire delta front to allow the multicorer to deploy properly. At these sites gravity cores were taken to supplement the poor multicore recovery. An attempt was made to collect cores across a range of depth conditions and distance from river mouth, since the optimal conditions for geochronology and determination of sediment accumulation rates (extremely fine grained sediment, no bioturbation) do not occur in the same samples as those which are optimal for benthic faunal signals of sedimentation disturbance. Figures 1a to 1 show the coring localities.

Multicores were extruded immediately upon retrieval. Generally two cores were cut up, one being reserved for geochronological work (primarily 210Pb and AMS 14C) and a second for paleobiological, stable isotope and sedimentological studies. Cores were extruded at 1cm intervals, with the entire interval being retained (double bagged) for sampling purposes.

In addition to multicoring operations, a number of gravity cores were taken for archival purposes. For this work we used LTBP's Duncan and Assoc. gravity corer, which takes a 6.8cm I.D. core, up to 2m in length. At most deltas at least one gravity core was collected at an optimal prior multicoring site, which will allow us to examine the physical stratigraphy of a larger interval of strata for each delta (Table 3).

A small, hand operated dive corer was brought on board and used at the Nyasanga/Kahama site after ship-deployed corers failed to work on as many sites as we desired to collect. However sediments were sandy at diveable depths (approximately 0- 30m) at these deltas and so core recovery with the hand corer was poor (Table 3).

All core samples and intact cores were shipped to the University of Arizona and Tulane University for paleobiological, sedimentological, geochemical and geochronological analysis following the cruise.

Water Samples

Water samples were collected to provide baseline data on 18O and Uranium/Thorium content in Lake Tanganyika and its influent streams (Table 2). This data will be invaluable for the ultimate interpretation of equivalent isotopic information from sedimentary proxies in our cores. Water was sampled in several ways. A Hydrobios water sampler attached to the Multicorer provided water samples from each successful multicoring site. This sampler triggers upon arrival of the corer on the lake floor, thus providing a very close approximation of the undisturbed water composition just above the sediment water interface. Occasionally this water sampler failed to trigger and we then deployed the GEF's stand-alone Hydrobios water sampler attached to the Explorer's hydrographic winch wire, collecting water samples from just above the lake floor at the coring site (as determined by the location of the sampler on the ship's echosounder). Finally, water samples were taken by hand from the mouths of the study rivers. All water samples were shipped to the US for analysis at the University of Arizona and the US Geological Survey (St. Petersburg, FL) following the cruise.

Overall Cruise Evaluation And Upcoming Short-term Workplan

Cruise operations, logistics and science activities all ran extremely smoothly on this cruise, thanks to the hard work of the many team members involved. The productivity of the cruise can be judged by the fact that our original coring plan was vastly exceeded Successful and timely completion of the planned coring targets during all legs of the cruise allowed us to obtain cores from two additional deltas (the Luiche and Gatorongoro) which were not originally planned for study. Also the number of cores obtained significantly exceeded our expectations.

In addition to our geological and limnological investigations, we were able to obtain key data on the timing of human population growth in the Mwamgongo area, through interviews with the village administrator and access to official Tanzanian census data for the Mwamgongo area. This data (which has been provided separately to the Socio- economic Special Studies group, and will be included in the Paleolimnology final report) indicates key intervals of population growth (notably the late 1940s

when Gombe Reserve was established and villagers within the park were resettled in Mwamgongo, and again in 1972, during the Ujamaa viligization program. This information will be extremely useful once our 210Pb chronology is established, in determining whether the timing of population growth was correlated with a significant increase in sedimentation rates, and whether these rate changes in turn correlate with limnologic and ecologic change in the Mwamgongo area of Lake Tanganyika. A high priority for LTBP!s socioeconomic survey data collection should be placed on obtaining comparable information on demographic histories for the other high disturbance coring sites (Luiche, Karonge/Kirasa, and Gatorongoro), either through traditional census and interview techniques, or through the evaluation of repeat historic photographs of coastal village areas (perhaps obtainable through national archives or in museum collections in Europe).

TABLE 3. LIST OF SAMPLING STATIONS, SAMPLE TYPES AND SUMMARY OF NOTES ON CORES COLLECTE

FIGURE 1a-e. BATHYMETRIC MAPS AND SAMPLING LOCATIONS FOR STUDY DELTAS.

Maps were generated using SURFER FOR WINDOWS 6.0, using normal krigging gid procedures and 0 anisotropy. Shorelines were calculated from 1:50,000 base maps. Grid line maps are available on request. Approximately 2,000 control points define each map area. See Table 3 for sample types noted on the maps

Back to office consulting report "Lake Tanganyika 1998 Survey" Lake Tanganyika Biodiversity Project / NRI / UNDP

Consultant: Dr Kiram LEZZAR Ref. No.: 1073 Project Number: C0765

REPORT (Timetable from January 14th to February 3rd, 1998)

*Day 1 (Jan 14th) Departure from Paris by SwissAir

*Day 2: Jan 15th Arrival at Dar Es Salaam. Visit to A. Menz. Introduction to the project.

*Days 3 to 6: Stalled at Dar Es Salaam, ATC flights cancelled (storms and raining problems).

*Day 7: Departure to Kigoma (via Mwanza). One night at the Lake Tanganyika Beach Hotel Kigoma.

*Day 8: First day on the Explorer. Last coring day of Leg 1 in the Tanzanian waters. Introduction to the team members (Andy Cohen, Manuel Palacios and Jim McGill) and training on the use and operation of the equipment.

*Day 9: Departure to Bujumbura (Burundi). Arrival to the Port at 10 pm. We anchored outside the port to overnight.

*Day 10: Entrance to Bujumbura Harbour (8 am). Customs clearance and fueling. Meeting with the international team and Kelly West. The Team lead by Manuel Palacios consisted of the following scientists: Gaspard Bikwemu, Tharcisse Songore, Louis Nahirzana, Gerard Ntungumburanye (from Burundi), Bombi Kakogozo (from Congo), Kiram Lezzar (from France), David Dettman, Katherine O'Reilly and Jeffrey Houser, and Kelly West as scientific liaison (from the USA). By 3 pm we left to start the bathymetric mapping of the proposed sites.

As we were cruising to the area of interest Manuel Palacios introduced the research project goals and procedures and I translated and commented to French for francophones. Our objectives were to recognize the deltaic systems offshore the Karonge, Kirasa, Nyamusenyi and Gatororongo Rivers and to core them systematically to study the environmental impact of deforestation over the past few centuries.

At 4.30 pm we arrived to the site and initiated the bathymetric survey on the Burundian platform, slope and basin.

At 7.30 pm end of work. Given the political instability of Burundi, we agreed to return to Bujumbura Port every night to anchor offshore and be able to leave at dawn every morning.

*Day 11: Departure from Bujumbura at 4 am. Arrival on site at 5:30 am. Starting bathymetric surveys. Our goal was to complete the bathymetric lines today. North-South and East-West lines were ran at 1 km intervals. Additionally, we ran two diagonal lines to cut the deltas. To ensure efficiency and participation of all, 11, scientists Manuel and I suggested to do a continuous recording operation with 5 teams of 2 scientist each. I was responsible for supervising the French-speaking scientists. The task was completed by 8 pm. All the bathymetric lines were shot. Back to Bujumbura. After dinner we prepared the bathymetric map to find the deltaic bodies formed by the river systems (Karonge, Kirasa, Nyamusenyi and Gatororongo rivers).

Team discussion to define the coring sites. The deltas are very small and developed on top of a very steep offshore fault - the West Ubwari Fault north of Cape Magara (Lezzar et al., 1996, Basin Research Journal, Blackwell Oxford) -the zone comprising 'platform-slope and deep basin' is very narrow. Thus, we observed that the platform can be very narrow and the shelf-break (platform-slope transition) can be very close to the shoreline. On this platform the depths can change very rapidly because of

the important of local rivers coarse detrital inputs but also due to the important faulting influence on the lacustrine topography in this tectonically active area (Lezzar, 1997, Doctorat PhD Thesis). The slope is very steep and sometimes rocky in the studied zones (Cohen et al., 1997; Basin Research Journal, Blackwell Oxford) , so we used this information to take care of the stuff during the coring operations.

Once the Karonge and Kirasa deltas were recognized we decided to sample them in their upper shallow and lower deeper parts (bathymetric and locations maps will be sent by the University of Arizona team's final report). In contrast to most of the Tanzanian deltas, these Burundian deltas are very narrow and numerous depending on the numerous related small rivers inshore. For this reason, it was difficult to map them in details with a high degree of precision. Thus, we decided to shoot additional diagonal bathymetric lines to constrain the areas. This gave us the information to observe the deltas's detailed geometry.

*Days 12 to 15: Coring operation. Despite the steep bottom morphology and sedimentary features (coarse sands to clays) all the deltaic bodies were sampled with a high degree of success for the multicorer operation in all part of the deltas. However, the gravity core operation was a problem in this kind of substrate. Gravity cores were targeted at relatively shallow waters (<70 m), but here sediments were too coarse for successful penetration. We tried to use a maximum of weight with no success.

We completed the coring operation in four days working from 6 am to 7 pm everyday. As we were 10 scientists for this operation, we organized the work in two similar teams. Each one was in charge of the complete work (sampling with multicorer, subsampling cores and bagging). This organization allowed all participants (english and french speaking) to contribute to all the phases of thesurvey. Burundian and Zairian participants were 100 percent involved in the work, increasing our efficiency and created an excellent work atmosphere on board.

As many of the sampled cores show interesting alternating sediment facies (sands, silts and clays), a particular recommendations must be done concerning their origin. Recent work in this area (Lezzar et al., 1996; Cohen et al., 1997; Lezzar, 1997) shows that the northern Lake Tanganyika is a tectonically active area a factor that influenced sedimentation throughout the lake's history. Thus, the role of tectonic activity must be differentiated from the role of the climate changes and/or the human deforestation impact. I think that in addition to the sedimentological, geochemical and micropalaeontological studies, a detailed study of the recent earthquakes in this area is indispensable to differentiate between these parameters. Their recognition would allow us to model the infilling processes that we have sampled on the numerous deltas.

Evening of Day 15: End of the survey. Departure from Bujumbura to Kigoma.

*Days 16 to 17: Arrival to Kigoma Port. Unloading of equipment, samples and materials from the Explorer to the Lake Tanganyika Biodiversity Project's office.

*Day 18: Storage of equipment at LTBP. Packaging, labeling and cutting of the gravity cores collected during Leg 1 in Tanzanian waters. All multicorer samples were also stored in boxes for transport to Dar Es Salaam.

*Day 19: A last meeting with all the team. Directed by Kelly West.

*Day 20: Departure from Kigoma to Dar Es Salaam by ATC Flight. Left some boxes at LTBP main offices in Dar Es Salaam to Andy Menz.

*Day 21 (February 3rd) Departure from Dar Es Salaam to Paris (via Zurich) by Swiss Air.

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CRUISE REPORT

Manuel R. Palacios-Fest

(December 29, 1997 to February 5, 1998)

The Lake Tanganyika Biodiversity Project Special Study on Sediment Discharge and Its Consequences began on January 2. Team members traveled between December 29, 1997 and January 1, 1998 to Dar Es Salaam. From Tanzania's capital the team flew to Kigoma Port, the operations center. Between January 2 and 6 the team loaded equipment, materials and personal belongings to the R/V Lake Tanganyika Explorer. The equipment (Hedrick-Marrs Multicorer and Duncan Gravity Corer) was tested on January 5 just outside the Kigoma Bay. The research sampling cruise was divided into three Legs as follows:

CRUISE PARTICIPANTS:

LEG 1 (January 6-16) Dr. Andrew S. Cohen- Cruise Leader and Chief Scientist Dr. Graeme Patterson- Project Director Dr. Manuel R. Palacios- Project Coordinator and Paleontologist Dr. Peter Swarzensky- Geochemist Dr. Dirk Verschuren- Paleolimnologist Mr. James McGill- Operations Engineer Ms. Emma Msaky- Palynologist Mr. Robert Sinyinza- Natural Resources specialist Mr. Mutanga Syapila- Natural Resources specialist Ms. Catherine O'Reilly- Limnologist Mr. Jeffrey Houser- Limnologist

LEG 2 (Jan 19-24) Dr. Andrew S. Cohen- Cruise Leader and Chief Scientist Dr. Manuel R. Palacios- Project Coordinator and Paleontologist Dr. Kiram Lezzar- Paleolimnologist Dr. David L. Dettman- Geochemist Mr. James McGill- Operations Engineer Mr. Robert Sinyinza- Natural Resources specialist Mr. Mutanga Syapila- Natural Resources specialist Ms. Catherine O'Reilly- Limnologist Mr. Jeffrey Houser- Limnologist

LEG 3 (Jan 24-28) Dr. Manuel R. Palacios- Cruise Leader and Coring Engineer Dr. Kiram Lezzar- Paleolimnologist Dr. Gaspard Bikwemu- Palynologist Dr. David L. Dettman- Geochemist Dr. Louis Nahimana- Sedimentologist Dr. Bombi Kakogozo- Limnologist Dr. Gerard Ntungumburanye- Geologist Dr. Tharcisse Songor-e Geologist Dr. Kelly West- Scientific Coordinator Ms. Catherine O'Reilly- Limnologist Mr. Jeffrey Houser- Paleolimnologist

AREAS OF STUDY During Leg 1 four deltas in Tanzanian waters were targeted, Lubulungu (Mahali National Park), Kabesi (north of Mahali National Park), Gombe Stream (Gombe Stream National Park) and Mwamgongo (north of Gombe Stream National Park). Leg 2 included the Luiche Delta, south of Ujiji, Tanzania. Leg 3,in Burundi, included four deltas: Karonge, Kirasa, Nyamusenyi and Gatororongo. All four deltas are in the same area around Gitasa.

TECHNICAL APPROACH At each Leg bathymetric surveys and coring operations were conducted systematically, as follows:

Bathymetric Surveys To define the coring sites bathymetric surveys were conducted at all study localities. Based on grids previously prepared at the University of Arizona, transects were spaced half- kilometer and data regularly measured at 0.05 nautical miles (occasionally at 0.02 miles) intervals. Commonly, besides the E-W and N-S transects some diagonal lines were run to highlight the deltas. This approach turned out to be very useful when constructing the bathymetric maps. Preliminary bathymetric maps were made on board to recognize the deltaic structure and establish the coring stations.

Coring Operations Two types of coring devices were used during the Lake Tanganyika Cruise, the Hedrick-Marrs multicorer and the Duncan Gravity Corer. The Hedrick-Marrs multicorer proved to be a very useful instrument. It consists of a frame (spider-like) from which four corers are placed at the center at equal distance from each other to avoid interference. The liners are 60 cm long and have an optimal penetration capacity of 57 cm. Given the fine and soft substrate the frame was equipped with stabilizers to avoid overpenetration (snowshoes and a central plate attached to the lower weights). These accessories were very efficient in most cases.

Coring capacity by the multicorer allowed us to collect sediments in a variety of conditions ranging from flat, fine sediments to steep slopes and coarse sand surfaces. Coring depths ranged from 29 to 394 m. Core lengths averaged 40 cm but occasionally we obtained shorter samples and only twice the multicorer overpenetrated the substrate (one during the Tanzanian cruise and one at the Burundian cruise). The multicorer was deployed from the back deck starboard side. This operation was somehow annoying because the device had to be lifted over the ship's rail with the consequent risk to the team members and the instrument itself. However, coring resulted easy and successful. From 90 attempts 46 produced at least one core. Speaking in baseball terms, our coring average was 0.510. Since one of our major goals is to date this material through 210Pb, undisturbed sediments were required. The multicorer produced extremely well preserved samples.

Additionally, some gravity cores were collected in most of the deltas to build a stratigraphic column representative of the delta. The Duncan Gravity Corer is a simple device capable of collecting 2 m long cores. In contrast to the multicorer, the gravity core disturbs the surface sediments at impact, but may allow to obtain a much longer record. This is particularly important to know the geologic history of the lake by means of 14C dating and the stratigraphic record. About 17 sites were attempted with 10 cores recovered, that is a 0.588 record. Most cores were shorter than 1 m, and only 4 exceeded this length.

Other Samples Water samples were collected to be analyzed for 18O and U/Th content in the lake and associated drainages. Water samples were collected primarily from the same coring sites by means of a Hydrobios (Niskin) water bottle attached to the multicorer. Water samples were recovered only from successful coring sites, although the water sampler triggered many more times than the cores. An advantage of this device is that allows sampling an undisturbed water sample very close to the bottom substrate, triggering at contact with surface and just before the core barrels penetrate the sediments. To compare water composition between the lake and its influents we also collected river water samples by hand.

All samples (cores and water) were shipped to the USA for analysis at the University of Arizona and the US Geological Survey (St. Petersburg, FL) following the cruise.

Cruise Evaluation The Lake Tanganyika cruise was a successful experience that allowed us to accomplish our scientific goals. The three legs produced a high quality set of samples for analysis. We expect to complete an equally successful analytical part. During Legs 1 and 2 team work was organized in such a manner that people kept doing systematically the same activity with little opportunity for the local trainees to be more involved in the actual operation of instruments and techniques. Aware of this inconvenience, at Leg 3 we conducted a rotational operationsprocedure. We guaranteed that every participant took responsibility of at least one coring operation and everyone had a chance to subsample the cores with the extruders, daily. Additionally, we were able to take advantage of the two extruders available on board and established two sampling teams one lead by Kiram Lezzar and the French-speaking scientists and the other lead by me. Dirk's Verschuren extruder proved to be an excellent tool for that purpose. We declined using the Duncan Gravity Corer after four attempts (only one short core), it was very difficult and dangerous to give instructions in English and wait for the French translation when lifting a 300+ lbs. device. Other than that, this was an extremely enjoyable experience.

UNDP-GEF "The Lake Tanganyika Biodiversity Project" University of Arizona paleolimnological cruise of the Tanganyika Explorer Report on coring operations during the first leg, 07-01-98 to 16-01-98 Dirk Verschuren, University of Gent, Belgium A. Hedrick-Marrs multicorer Dockside preparation of the multicorer comprised (1) assembly of the standard version of the apparatus, (2) installation of the water bottle (which had been ordered separately), and (3) attachment of customized feet ("snowshoes") to the support frame and central corer unit to improve stability of the corer on the lake bottom and prevent overpenetration of the core tubes in soft sediments. Installation of the water bottle required construction of a fixture for attachment to a strut on the support frame, drilling of additional bolt holes in the support strut and the top plate, and assembly of a bottle triggering setup and a safety

line. The four main support feet were made from 1/3" thick PVC sheet, each 1x2 ft in size, and attached with 3/8" wingnut-bolts to pre-drilled holes in the legs of the support frame. Swiveling of the feet was prevented by two additional bolts fitting as loose pins into pre-drilled air-escape holes at the bottom of the legs. The fifth support foot consists of a haltershaped PVC plate with a surface area of about 3 square ft, and was attached to the central column of the corer with four 3/8" bolts screwed in threaded holes tapped into the two 25 lbs. lead weights that are suspended from the central corer unit. The multicorer was further modified early into the cruise by cutting through the sides of 7 other 25 lbs. leadweights to the holes that fit them over two weightstand rods on top of the central unit. This allowed addition or removal of leadweights without having to unscrew the capping plate and main eye bolt from which the corer is suspended during deployment. The multicorer was deployed suspended from a swivel shackle attached to the starboard winch cable, which ran through a pulleyblock attached to a 3 ft welded extension of the A frame at the stern of the boat. Typically the corer stood on the back deck at night and was set overboard each morning; during daytime transit between coring sites it was secured with rope to the side of the boat. The four main support feet were attached to the legs with the corer in tilted position during its transfer from the deck to the side of the boat. Core tubes and their brackets were installed, springloaded before sampling, and removed after sampling all while the corer hang overboard, with the tubes secured to a safety line when not securely fastened to the corer. Adding or removing lead weights onto or from the weightstand was also done while the corer hang overboard. Two safety wingnuts immobilized the central corer unit in relation to the support frame at all times when the corer was not actually in the water. The multicorer was deployed in water depths between 59 and 394 m. At the Lubulungu and Kabesi River deltas it consistently retrieved a near-bottom water sample and three or four cores of undisturbed soft surface sediments ranging from flocculent organic muds to more cohesive clays and sands. At the Mwamgongo and Gombe Stream deltas, successful recovery depended on finding bottom areas with sufficiently gentle slope to allow accumulation of soft sediments (cf. below). Most of the time bottom water collected inside the core tubes was perfectly clear, demonstrating the absence of sediment resuspension that would be caused by bow wave formation or sliding of the support frame over the lake bottom immediately prior to sediment penetration. The weightstand was usually loaded with 250 lbs. on sandy substrates and 200 lbs. on muddy substrates, with lowest loads of 75 lbs. used in 189 m depth at the Lubulungu River delta (LT98-13M) and in 394 m on the Kalemie Ridge (LT98-25M). Recovery varied between 10 cm on consolidated sandy clay substrate (LT98-11M, LT98-38M) and a record 58 cm on organic muds (LT98-49M). The high proportion (7 out of 21) of successful coring attempts with a recovery of 50 cm or higher suggests that the haltershaped support foot attached to the central corer unit often effectively stopped further penetration. Overpenetration of the corer and core tubes occurred only once, when using 150 lbs. of weight on organic muds at 393 m depth (LT98-24M, discarded). In general, the Hedrick-marrs multicorer was found to be a splendidly designed machine, and its operation presented few difficulties. A minor handicap was created during work at the Kabesi River delta when preventive tightening of the spring-loaded shovel arm of one of the core tube brackets resulted in cracking of a PVC part in the arm's elbow joint. Only three core tubes could be used for sampling until the part was repaired during a stopover in Kigoma. Unsuccessful attempts at Mwamgongo Gombe can be attributed to a combination of possibly impenetrable rocky or gravelly substrates with the prevalence of bottom slopes too steep for normal operation of the corer. Evaluation of cable behavior during corer deployment and condition of the closure mechanism upon corer retrieval suggests that displacement of the corer's high center of gravity on steep slopes may have impeded descent of the corer's central unit relative to the support frame after settling on the lake floor. Moderate damage to the PVC support feet indicate that they may occasionally have been caught under large angular rocks, and loss of two lead weights during the final coring attempt at Gombe suggests that the corer may have fallen on its side at that time. One possible improvement to use of the multicorer on the Tanganyika Explorer is that it should be possible to lead the main winch cable to a pulleyblock suspended from the U-shaped extension on the back of the A-frame, so that the multicorer can be deployed from the stern of the boat rather than the starboard side. B. Gravity corer The used gravity corer is a simple instrument collecting up to 2-m long cores of muddy and clayey lake sediments; performance is generally poor on sandy bottoms. The gravity corer also tends to disturb the in situ profile of soft surface sediments because (1)

the bow wave created in front of the corer during descent blows away soft surficial deposits upon arrival at the bottom, so that the recovered core section lacks the original sediment surface; (2) the core catcher diaphragm opens only when moving through fairly consolidated sediments, so that soft surface muds are pushed into the tube inbetween the core catcher blades; and (3) the corer is lowered horizontally on deck upon core recovery, so that soft surface muds are sloshed around in the tube. Further, the design of this particular gravity corer has three shortcomings: (1) the fine thread of the connection between the nose cone and the core barrel invites problems with sand grains getting stuck in the thread and blocking movement between the parts; (2) overengineered dimensions of the core barrel (3/16" wall) and the polycarbonate core liner (1/8" wall) together create a cross section of displaced sediment that is an estimated 60% greater than the cross section of the collected sediment (for comparison: in the Hedrick-Marrs corer this value is only 12%), which is rather unacceptable after three decades of published studies on the phenomenon of core 'compression' or 'shortening'; and (3) poorly placed handles on the core barrel are a hazard during deployment and may also prevent penetration beyond about 1.5 m depth. During the present cruise, the gravity corer was used mainly to retrieve core profiles of the more consolidated deposits at sediment depths below those recovered with the multicorer. Thus, recovery could be considered successful if correlation of visible stratigraphy could be established between the top of the gravity core and the bottom of the multicorer profile collected from the same location. About 8 cores were collected, 4 of which exceed one meter in length. During work at Mwamgongo the nose cone could no longer be unscrewed from the core barrel, most probable due to sand getting stuck in the threaded connection. Repair necessitated a stopover in Kigoma and extensive refiling the thread on the core barrel; burrs created by forceful manipulation of the parts with wrenches rendered one nose cone unsuitable for further use.

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LAKE TANGANYIKA BIODIVERSITY PROJECT
CORING CRUISE (SHORT REPORT) - Emma Msaky

DURATION: 14 days (5.1.98 to 19.1.98) 5.1.98: Arrived at Kigoma 6.1.98: Bathmmetry maps for the area to be cored were prepared. Coring sites were picked from these maps. 7.1.98 - 16.1.98:

CORING: Intense coring was done on selected deltas and sites by using the vessel RV Tanganyika Explorer. Material collected will be used for paleolimnological and playnological analyses, also will be used for an exploration of the changing impact of sediments. The analyses of fossil remains of both lake organism and watershed plant pollen as well as radiochemical traces, will allow an understanding of changes that have occurred in the lake over the past several years. Both Gravity cores and Multicores were collected. Coring sites: Areas around Mahale mountain National parks, Gombe stream National parks and at River Deltas. About 71 cores were collected. These include multicores and Gravity cores. Water samples were also collected while coring. Most of the multicores were between 40cm and 55cm length. In most cases organic muddy clay cores were collected. Occasionally cores with sand layers, ?diatom layers, laminations (organic and inorganic clays) and carbonate precipitation (whitish) layers were also collected. Sample description and parking: From the collected cores samples were taken after each centimeter, described and parked. Samples for radiometric studies were also taken after each centimeter and parked. Shell fragments (snails), pieces of charcoal, plant remains (twigs, woods, roots, leaves), coconut shells and fish bones were found in some samples. Live zooplankton /epibenthos, copepods, ostracodes and flocculent algae were also present in some samples. All these are useful in determining the palaeoenvironment of the area, also to study the changes bought about by human activity for the past several years. Comments: During coring the weather was fairly calm and good with a few rough days. It was a good opportunity for me to participate in coring cruise (in offshore operations). 19.1.98: Left Kigoma for Dar es Salaam.

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REPORT ON SEDIMENT SAMPLING EXERCISE IN KIGOMA FROM 6TH -20TH JAN ,1998.

COMPILED BY ROBERT SINYINZA AND MUNTANGA SYAPILA

1. PARTICIPANTS

1. Dr. ANDY COHEN (HEAD OF TEAM) 2. Dr GRAEME PATTERSON 3. Dr MANUEL PALACIOS 4. PIET SWARZENSKI 5. ROBERT SINYINZA 6. JIM MCGILL 7. MUNTANGA SYAPILA 8. DIRK 9. EMMA MSAKI (Mrs)

2. AIM OF SEDIMENTATION SAMPLING.

To collect sediment samples and determine the rate of sedimentation by dating in Lake Tanganyika

3. AREAS OF SAMPLING

The Mahale,Gombe and Mwamungongo area river deltas were the suitable sites for sampling.There are a lot of sediments flowing into the lake from the cathment area being eroded and transported by the rivers.The following river deltas were done ,the Lubulungu,Kabesi,Nyaranga,Kahama, Mwamgongo and Luiche.Water samples were collected from the above rivers / streams.The sample bottles were well secured devoid of air bubbles. 4. CORING EQUIPMENT The coring was done by two coring equipment ,a multicorer and a gravity corer.The multicorer was being used for the first time on LakeTanganyika.

The multicorer has four transparent cores on the mainframe.Attached to the frame is also a water sampler.The sediments and the water sample were extracted at the same depth.The cores on the multicorer are made from strong material which can resist hard and rough bottom surfaces.The gravity corer is one metal pipe which was being lined with polypoplene transparent pipe to collect the sediments.It is secured at the bottom to prevent sediments from leaking out.The two equipment were reinforced with lead weights for easy sinking into the water and the sediments.

The echo - sounder on the research vessel was used for depth measurements.The G.P.S was used for getting the grid references,North - South and East - West. When sediment samples were collected by the multicorer , the four cores were examined and the best two were picked.Each one of the cores was subdivided into 1cm slices and clearly described.The description was in terms of colour , texture (whether sandy or silty) presence of shells and or any other benthos , dead wood , mottles of remains of algae , presence of worms , precipitates or decaying algae on the surface , presence of micaceous minerals, or copepods on the surface water as examples.

5. CORING/SAMPLING EXERCISE

Before the actual coring work , a bathymetric mapping exercise was done by making transects of grids and corresponding depths.From the grids and depth measurements a bathymetric map was prepared.Suitable coring sites were picked from the bathymetric map.

6. OBSERVATIONS

The multicorer could not do well in very steep slopes of the Gombe area.The gravity cover was a good lest of the type of lake bottom expected.Sandy and rocky slopes were not very good coring sites.Coring was successfully done in " flat " areas where there's a lot of mud or silt.The only disadvantage of the silty sites was over penetration. The sediments in the cores were showing horizons differing in colours and textures e.g 0cm - 1cm ,mud 1- 2cm olive green clay. In certain cases there were significant changes in the colour and texture of the cores from top to bottom.The presence of materials transported from the inhabited area of Mwamgongo were evident in the sediments e.g charcoal ,peanut shells.There was also a strong relationship observed between the colours of the top most slice of the sediments and the cultivated mountain slopes of Mwamgongo.

7. HUMAN POPULATION INFLUENCE ON SEDIMENTATION.

Efforts were made to look for historical demography records of changes in population for the inhabited area of Mwamgongo in order to find the relationship between the changes in in the periods of sedimentation after laboratory analysis of the samples with the changes in the population figures.

8. NOTE The analysis of the sediments and water samples will be done by Dr Andy Cohen in Arizona ,U.S.A.The method of dating will be by use of radio Isotopes e.g 14c Isotopes and oxygen Isotope on the water source.

9. IMPORTANT LESSONS LEARNT FROM SEDIMENT EXERCISE IN KIGOMA

(I) Purpose and importance of sediment work studies in Lake Tanganyika (ii) Geographic and bathymeric mapping of areas of sampling. (Iii) Choice of key areas of sediment sampling and sediment origins. (Iv) Precise description of sediments samples collected and handling of sediment samples (V) Equipment choice and equipment short comings.

SEDIMENT SAMPLING IN MPULUNGU We would like to immediately commence sediments sampling work in Mpulungu and your encouragement is wellcome. So far Sinyinza has had opportunities to be oriented in sediment work with Ken Irvine ,Rob Duck and Andy Cohen.In addition Kaoma and Kasonde attended the workshop last year and Syapila has had the latest orientation with Andy Cohen.

AIM OF SEDIMENT WORK Our aim of sediment work in Mpulungu is to investigate and describe the nature of the sediments found in the delta areas and the habitat mapped areas of Lake Tanganyika.The habitat mapped areas are the areas mapped by the biodiversity special study group (Divers).We aim to provide the basic data on sediments.

ANALYSIS OF SAMPLES The analysis of the nature of samples will be described in terms of both physical and basic biochemical parameters. Physical parameters in terms of shape of particles ,grain size and sorting.Biochemical parameters in terms of Calcium Carbornate (Ca Co3), content presence of organic matter and or living organisms.

REQUIREMENTS AND PROPOSALS The basic equipment for this work is a grab ,lenses ,trowels ,field cards and oven for drying samples.The ekman grab we collected from Kigoma is alright but from experience it has the disadvantage of being light.In sand and gravelly bottoms it does not do well.We propose for a Windermere grab. In addition ,we propose to have a short and handy gravity corer that we can be utilised in the littoral zones for us to determine the differences or fluctuations of biodiversity in the sediments.. LITERATURE AND GUIDELINES

We need to have literature and guide lines to support our work.The best literature proposed would be books or publications on the impact of sedimentation on specific ecosystems or benthic organisms ,limnological impacts of sediments on ecosystems .

BOAT , TIME AND PARTICIPANTS Two days of boat time is necessary but this may fluctuate from time to time depending on the amount of work and distances.not every one of the four ,Sinyinza ,Kaoma ,Syapila and Kasonde would be available for collection and analysis of samples at one particular time .There is also a pool of Fisheries Assistants who can accompany any one of the above on the sediment sampling exercise.Above all we encourage team spirit from the above four to do an excellent job.